

The following is a complete listing of all claims in the application, with an indication of the status of each:

**Listing of claims:**

- 1           1. (canceled)
- 2           2. (currently amended) A network connection system for connecting a first  
3           communication network and a plurality of user terminals when a second  
4           communication network is interposed between said first communication  
5           network and said plurality of user terminals, said second communication  
6           network employing a second protocol different from a first protocol employed  
7           in said first communication network, said system comprising:  
8                 a scheduling apparatus including:  
9                         a classification processing unit for classifying data conforming  
10                        to said first protocol received from said communication network based  
11                        on quality guaranteed classes set thereto;  
12                        an overhead amount correction unit for correcting an overhead  
13                        amount between a data rate associated with said first protocol and a  
14                        data rate associated with said second protocol to convert received rate  
15                        information on said second protocol to the rate based on said first  
16                        protocol;  
17                        a weighting coefficient calculation unit for calculating a  
18                        weighting coefficient based on said rate calculated by said overhead  
19                        amount correction unit such that a minimally guaranteed rate is  
20                        assured for a minimum rate guaranteed class among classes classified  
                      by said classification processing unit;

a weighting scheduler for scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on the weighting coefficient calculated by said weighting coefficient calculation unit to deliver the data in accordance with the scheduling; and

a scheduler for scheduling the data conforming to said first protocol from said weighting scheduler such that the data conforming to said first protocol is delivered at a transmission rate equal to or lower than said rate calculated by said overhead amount correction unit to deliver the data in accordance with the scheduling;

a protocol converter for converting the data conforming to said first protocol after said scheduling apparatus has shaped the transmission rate therefor to data conforming to said second protocol; and

a multiplexer including a current ~~data rate~~ detector for supplying said scheduling apparatus with said rate information as indicative of a currently set reception rate for said user terminals, said multiplexer being configured to transmit to each of said user terminals the data conforming to said second protocol from said protocol converter or the data conforming to said first protocol after said scheduling apparatus has shaped the transmission rate therefor.

3. (currently amended) A network connection system for connecting a first communication network and a plurality of user terminals when a second communication network is interposed between said first communication network and said plurality of user terminals, said second communication network employing a second protocol different from a first protocol employed in said first communication network, said system comprising:

a scheduling apparatus including:

a classification processing unit for classifying data conforming to said first protocol received from said communication network based on quality guaranteed classes set thereto;

an overhead amount correction unit for correcting an overhead amount between a data rate associated with said first protocol and a data rate associated with said second protocol to convert received rate information on said second protocol to the rate based on said first protocol;

a weighting coefficient calculation unit for calculating a weighting coefficient based on said rate calculated by said overhead amount correction unit such that a minimally guaranteed rate is assured for the minimum rate guaranteed class among classes classified by said classification processing unit;

a weighting scheduler for scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on the weighting coefficient calculated by said weighting coefficient calculation unit to deliver the data in accordance with the scheduling; and

a preferential control scheduler for scheduling the data conforming to said first protocol from said weighting scheduler, and data conforming to said first protocol of a best-effort class among said classified classes such that the data conforming to said first protocol is delivered at a transmission rate equal to or lower than said rate calculated by said overhead amount correction unit, and for preferentially scheduling the data conforming to said first protocol from said weighting scheduler, and delivering the data conforming to

35 said first protocol of the best-effort class at a timing at which there is  
36 no data conforming to said first protocol from said weighting  
37 scheduler;  
38 a protocol converter for converting the data conforming to said first  
39 protocol after said scheduling apparatus has shaped the transmission rate  
40 therefor to data conforming to said second protocol; and  
41 a multiplexer including a current ~~data rate~~ detector for supplying said  
42 scheduling apparatus with said rate information as indicative of a currently set  
43 reception rate for said user terminals, said multiplexer being configured to  
44 transmit to each of said user terminals the data conforming to said second  
45 protocol from said protocol converter or the data conforming to said first  
46 protocol after said scheduling apparatus has shaped the transmission rate  
47 therefor.

1 4. (currently amended) A network connection system for connecting a first  
2 communication network and a plurality of user terminals when a second  
3 communication network is interposed between said first communication  
4 network and said plurality of user terminals, said second communication  
5 network employing a second protocol different from a first protocol employed  
6 in said first communication network, said system comprising:  
7 a scheduling apparatus including:  
8 a classification processing unit for classifying data conforming  
9 to said first protocol received from said communication network based  
10 on quality guaranteed classes set thereto;  
11 a rate measuring unit for measuring a transmission rate for a  
12 preferential class among said classified classes;  
13 an overhead amount correction unit for correcting an overhead  
14 amount between a rate based on said second protocol and a rate based

on said first protocol to convert received rate information on said second protocol to the rate based on said first protocol;

a weighting coefficient calculation unit for calculating a weighting coefficient based on said rate calculated by said overhead amount correction unit and the transmission rate for the preferential class measured by said rate measuring unit such that a minimally guaranteed rate is assured for the minimum rate guaranteed class among the classes classified by said classification processing unit;

a weighting scheduler for scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on the weighting coefficient calculated by said weighting coefficient calculation unit to deliver the data in accordance with the scheduling; and

a preferential control scheduler for scheduling the data conforming to said first protocol of said preferential class, the data conforming to said first protocol from said weighting scheduler, and data conforming to said first protocol of a best-effort class among said classified classes such that the data conforming to said first protocol is delivered at a transmission rate equal to or lower than said rate calculated by said overhead amount correction unit, and for preferentially scheduling the data conforming to said first protocol of said preferential class, preferentially scheduling the data conforming to said first protocol from said weighting scheduler at a timing at which there is no data conforming to said first protocol of said preferential class, and delivering the data conforming to said first protocol of the best-effort class at a timing at which there is no data conforming to said first protocol from said weighting scheduler;

43 a protocol converter for converting the data conforming to said first  
44 protocol after said scheduling apparatus has shaped the transmission rate  
45 therefor to data conforming to said second protocol; and  
46 a multiplexer including a current ~~data rate~~ detector for supplying said  
47 scheduling apparatus with said rate information as indicative of a currently set  
48 reception rate for said user terminals, said multiplexer being configured to  
49 transmit to each of said user terminals the data conforming to said second  
50 protocol from said protocol converter or the data conforming to said first  
51 protocol after said scheduling apparatus has shaped the transmission rate  
52 therefor.

1 5. (currently amended) A network connection system for connecting a first  
2 communication network and a plurality of user terminals when a second  
3 communication network is interposed between said first communication  
4 network and said plurality of user terminals, said second communication  
5 network employing a second protocol different from a first protocol employed  
6 in said first communication network, said system comprising:

7 a scheduling apparatus including:

8 a classification processing unit for classifying data conforming  
9 to said first protocol received from said communication network based  
10 on quality guaranteed classes set thereto;

11 a rate measuring unit for measuring a transmission rate for a  
12 preferential class among said classified classes;

13 an overhead amount correction unit for correcting an overhead  
14 amount between a rate based on said second protocol and a rate based  
15 on said first protocol to convert received rate information on said  
16 second protocol to the rate based on said first protocol;

17 a preferential class upper limit setting unit, operative when the  
18 difference between the transmission rate of the data conforming to said  
19 first protocol of the preferential class as measured by said rate  
20 measuring unit and said rate calculated by said overhead amount  
21 correction unit is lower than a minimally guaranteed rate for a  
22 minimum rate guaranteed class among the classes classified by said  
23 classification processing unit, for setting an upper limit to the  
24 transmission rate for said preferential class for shaping, such that the  
25 minimally guaranteed rate can be assured for said minimum rate  
26 guaranteed class;

27 a weighting coefficient calculation unit, operative when said  
28 preferential class upper limit setting unit does not set the upper limit,  
29 for calculating a weighting coefficient based on said rate calculated by  
30 said overhead amount correction unit and the transmission rate for the  
31 preferential class measured by said rate measuring unit such that the  
32 minimally guaranteed rate is assured for the minimum rate guaranteed  
33 class among the classes classified by said classification processing  
34 unit, said weighting coefficient calculation unit being further operative  
35 when said preferential class upper limit setting unit sets the upper  
36 limit, for calculating a weighting coefficient based on said rate  
37 calculated by said overhead amount correction unit and the upper limit  
38 rate set by said preferential class upper limit setting unit such that the  
39 minimally guaranteed rate is assured for said minimum rate guaranteed  
40 class;

41 a weighting scheduler for scheduling data conforming to said  
42 first protocol of said minimum rate guaranteed class and of a  
43 weighting applied class among said classified classes based on the  
44 weighting coefficient calculated by said weighting coefficient

45 calculation unit to deliver the data in accordance with the scheduling;  
46 and  
47 a preferential control scheduler for scheduling the data  
48 conforming to said first protocol of said preferential class, the data  
49 conforming to said first protocol from said weighting scheduler, and  
50 data conforming to said first protocol of a best-effort class among said  
51 classified classes, such that the data conforming to said first protocol is  
52 delivered at a transmission rate equal to or lower than said rate  
53 calculated by said overhead amount correction unit, and for  
54 preferentially scheduling the data conforming to said first protocol of  
55 said preferential class, preferentially scheduling the data conforming  
56 to said first protocol from said weighting scheduler at a timing at  
57 which there is no data conforming to said first protocol of said  
58 preferential class, and delivering the data conforming to said first  
59 protocol of the best-effort class at a timing at which there is no data  
60 conforming to said first protocol from said weighting scheduler;  
61 a protocol converter for converting the data conforming to said first  
62 protocol after said scheduling apparatus has shaped the transmission rate  
63 therefor to data conforming to said second protocol; and  
64 a multiplexer including a current ~~data rate~~ detector for supplying said  
65 scheduling apparatus with said rate information as indicative of a currently set  
66 reception rate for said user terminals, said multiplexer being configured to  
67 perform DSL processing using telephone lines to transmit to each of said user  
68 terminals the data conforming to said second protocol from said protocol  
69 converter or the data conforming to said first protocol after said scheduling  
70 apparatus has shaped the transmission rate therefor.



6. (currently amended) A network connection system for connecting a first communication network and a plurality of user terminals when a second communication network is interposed between said first communication network and said plurality of user terminals, said second communication network employing a second protocol different from a first protocol employed in said first communication network, said system comprising:

a scheduling apparatus including:

a classification processing unit for classifying data conforming to said first protocol received from said communication network based on quality guaranteed classes set thereto;

an overhead amount correction unit for correcting an overhead amount between a rate based on said second protocol and a rate based on said first protocol to convert received rate information on said second protocol to the rate based on said first protocol;

a weighting coefficient calculation unit for calculating a weighting coefficient based on said rate calculated by said overhead amount correction unit and the transmission rate for a preferential class among said classified classes using information fed back from said user terminals such that a minimally guaranteed rate is assured for the minimum rate guaranteed class among the classes classified by said classification processing unit;

a weighting scheduler for scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on the weighting coefficient calculated by said weighting coefficient calculation unit to deliver the data in accordance with the scheduling; and

28 a preferential control scheduler for scheduling the data  
29 conforming to said first protocol of said preferential class, the data  
30 conforming to said first protocol from said weighting scheduler, and  
31 data conforming to said first protocol of a best-effort class among said  
32 classified classes such that the data conforming to said first protocol is  
33 delivered at a transmission rate equal to or lower than said rate  
34 calculated by said overhead amount correction unit, and for  
35 preferentially scheduling the data conforming to said first protocol of  
36 said preferential class, preferentially scheduling the data conforming  
37 to said first protocol from said weighting scheduler at a timing at  
38 which there is no data conforming to said first protocol of said  
39 preferential class, and delivering the data conforming to said first  
40 protocol of the best-effort class at a timing at which there is no data  
41 conforming to said first protocol from said weighting scheduler;  
42 a protocol converter for converting the data conforming to said first  
43 protocol after said scheduling apparatus has shaped the transmission rate  
44 therefor to data conforming to said second protocol; and  
45 a multiplexer including a current ~~data rate~~ detector for supplying said  
46 scheduling apparatus with said rate information as indicative of a currently set  
47 reception rate for said user terminals, said multiplexer being configured to  
48 perform DSL processing using telephone lines to transmit to each of said user  
49 terminals the data conforming to said second protocol from said protocol  
50 converter or the data conforming to said first protocol after said scheduling  
51 apparatus has shaped the transmission rate therefor.

1 7. (currently amended) A network connection system for connecting a first  
2 communication network and a plurality of user terminals when a second  
3 communication network is interposed between said first communication

4 network and said plurality of user terminals, said second communication  
5 network employing a second protocol different from a first protocol employed  
6 in said first communication network, said system comprising:

7 a scheduling apparatus including:

8 a classification processing unit for classifying data conforming  
9 to said first protocol received from said communication network based  
10 on quality guaranteed classes set thereto;

11 an overhead amount correction unit for correcting an overhead  
12 amount between a rate based on said second protocol and a rate based  
13 on said first protocol to convert received rate information on said  
14 second protocol to the rate based on said first protocol;

15 a preferential class upper limit setting unit, operative when the  
16 difference between the transmission rate for a preferential class among  
17 said classified classes determined to be using information fed back  
18 from said user terminals and said rate calculated by said overhead  
19 amount correction unit is lower than a minimally guaranteed rate for a  
20 minimum rate guaranteed class among the classes classified by said  
21 classification processing unit, for setting an upper limit to the  
22 transmission rate for said preferential class for shaping such that the  
23 minimally guaranteed rate can be assured for said minimum rate  
24 guaranteed class;

25 a weighting coefficient calculation unit, operative when said  
26 preferential class upper limit setting unit does not set the upper limit,  
27 for calculating a weighting coefficient based on said rate calculated by  
28 said overhead amount correction unit and the transmission rate for the  
29 preferential class such that the minimally guaranteed rate is assured for  
30 said minimum rate guaranteed class, said weighting coefficient  
31 calculation unit being further operative when said preferential class

upper limit setting unit sets the upper limit, for calculating a weighting coefficient based on said rate calculated by said overhead amount correction unit and the upper limit rate set by said preferential class upper limit setting unit such that the minimally guaranteed rate is assured for said minimum rate guaranteed class;

a weighting scheduler for scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on the weighting coefficient calculated by said weighting coefficient calculation unit to deliver the data in accordance with the scheduling; and

a preferential control scheduler for scheduling the data conforming to said first protocol of said preferential class, the data conforming to said first protocol from said weighting scheduler, and data conforming to said first protocol of a best-effort class among said classified classes such that the data conforming to said first protocol is delivered at a transmission rate equal to or lower than said rate calculated by said overhead amount correction unit, and for preferentially scheduling the data conforming to said first protocol of said preferential class, preferentially scheduling the data conforming to said first protocol from said weighting scheduler at a timing at which there is no data conforming to said first protocol of said preferential class, and delivering the data conforming to said first protocol of the best-effort class at a timing at which there is no data conforming to said first protocol from said weighting scheduler;

a protocol converter for converting the data conforming to said first protocol after said scheduling apparatus has shaped the transmission rate therefor to data conforming to said second protocol; and

60 a multiplexer including a current ~~data rate~~ detector for supplying said  
61 scheduling apparatus with said rate information as indicative of a currently set  
62 reception rate for said user terminals, said multiplexer being configured to  
63 perform DSL processing using telephone lines to transmit to each of said user  
64 terminals the data conforming to said second protocol from said protocol  
65 converter or the data conforming to said first protocol after said scheduling  
66 apparatus has shaped the transmission rate therefor.

1 8-11. (canceled)

1 12. (original) A traffic shaping method, in a network connection system for  
2 connecting a communication network and a plurality of user terminals, for  
3 shaping a transmission rate for data conforming to a first protocol from said  
4 communication network, said method comprising the steps of:

5 classifying data conforming to said first protocol received from said  
6 communication network based on quality guaranteed classes set thereto;

7 correcting an overhead amount between a rate based on a second  
8 protocol and a rate based on said first protocol to convert received rate  
9 information on said second protocol to the rate based on said first protocol;

10 calculating a weighting coefficient such that a minimally guaranteed  
11 rate is assured for a minimum rate guaranteed class among said classified  
12 classes based on said calculated rate;

13 scheduling data conforming to said first protocol of said minimum rate  
14 guaranteed class and of a weighting applied class among said classified  
15 classes based on the calculated weighting coefficient to deliver the data in  
16 accordance with the scheduling; and

17 scheduling the data conforming to said first protocol after said  
18 weighting, and data conforming to said first protocol of a best-effort class

19 among said classified classes, such that the data conforming to said first  
20 protocol is delivered at a transmission rate equal to or lower than said  
21 calculated rate, and for preferentially scheduling the data conforming to said  
22 first protocol after said weighting, so that the data conforming to said first  
23 protocol of said best effort class is delivered at a timing at which there is no  
24 data conforming to said first protocol after said weighting.

1 13. (canceled)

1 14. (original) A traffic shaping method, in a network connection system for  
2 connecting a communication network and a plurality of user terminals, for  
3 shaping a transmission rate for data conforming to a first protocol from said  
4 communication network, said method comprising the steps of:  
5 classifying data conforming to said first protocol received from said  
6 communication network based on quality guaranteed classes set thereto;  
7 measuring a transmission rate for a preferential class among said  
8 classified classes;  
9 correcting an overhead amount between a rate based on a second  
10 protocol and a rate based on said first protocol to convert received rate  
11 information on said second protocol to the rate based on said first protocol;  
12 calculating a weighting coefficient based on said calculated rate and  
13 the transmission rate measured for the preferential class such that a minimally  
14 guaranteed rate is assured for a minimum rate guaranteed class among the  
15 classified classes;  
16 scheduling data conforming to said first protocol of said minimum rate  
17 guaranteed class and of a weighting applied class among said classified  
18 classes based on the calculated weighting coefficient to deliver the data in  
19 accordance with the scheduling; and

20 scheduling the data conforming to said first protocol of said  
21 preferential class, the data conforming to said first protocol after said  
22 weighting, and data conforming to said first protocol of a best-effort class  
23 among said classified classes such that the data conforming to said first  
24 protocol is delivered at a transmission rate equal to or lower than said  
25 calculated rate, and for preferentially scheduling the data conforming to said  
26 first protocol of said preferential class, preferentially scheduling the data  
27 conforming to said first protocol after said weighting at a timing at which  
28 there is no data conforming to said first protocol of said preferential class, and  
29 delivering the data conforming to said first protocol of the best-effort class at  
30 a timing at which there is no data conforming to said first protocol after said  
31 weighting.

1 15. (original) A traffic shaping method, in a network connection system for  
2 connecting a communication network and a plurality of user terminals, for  
3 shaping a transmission rate for data conforming to a first protocol from said  
4 communication network, said method comprising the steps of:  
5 classifying data conforming to said first protocol received from said  
6 communication network based on quality guaranteed classes set thereto;  
7 measuring a transmission rate for a preferential class among said  
8 classified classes;  
9 correcting an overhead amount between a rate based on said second  
10 protocol and a rate based on said first protocol to convert received rate  
11 information on said second protocol to the rate based on said first protocol;  
12 when the difference between said measured transmission rate of the  
13 data conforming to said first protocol of the preferential class and said  
14 calculated rate is lower than a minimally guaranteed rate for a minimum rate  
15 guaranteed class among said classified classes, setting an upper limit to the

transmission rate for said preferential class for shaping such that the minimally guaranteed rate can be assured for said minimum rate guaranteed class;

calculating a weighting coefficient based on said calculated rate and said transmission rate measured for the preferential class such that a minimally guaranteed rate is assured for said minimum rate guaranteed class, when the upper limit rate is not set for said preferential class, and calculating a weighting coefficient based on said calculated rate and said set upper limit rate such that the minimally guaranteed rate is assured for said minimum rate guaranteed class when the upper limit rate is set for said preferential class;

scheduling data conforming to said first protocol of said minimum rate guaranteed class and of a weighting applied class among said classified classes based on said calculated weighting coefficient to deliver the data in accordance with the scheduling; and

scheduling the data conforming to said first protocol of said preferential class, the data conforming to said first protocol after said weighting, and data conforming to said first protocol of a best-effort class among said classified classes such that the data conforming to said first protocol is delivered at a transmission rate equal to or lower than said calculated rate, preferentially scheduling the data conforming to said first protocol of said preferential class, preferentially scheduling the data conforming to said first protocol after said weighting at a timing at which there is no data conforming to said first protocol of said preferential class, and delivering the data conforming to said first protocol of the best-effort class at a timing at which there is no data conforming to said first protocol after said weighting.



1 16. (original) A traffic shaping method, in a network connection system for  
2 connecting a communication network and a plurality of user terminals, for  
3 shaping a transmission rate for data conforming to a first protocol from said  
4 communication network, said method comprising the steps of:  
5 classifying data conforming to said first protocol received from said  
6 communication network based on quality guaranteed classes set thereto;  
7 correcting an overhead amount between a rate based on a second  
8 protocol and a rate based on said first protocol to convert received rate  
9 information on said second protocol to the rate based on said first protocol;  
10 calculating a weighting coefficient based on said calculated rate and  
11 the transmission rate for a preferential class among said classified classes  
12 determined to be using information fed back from said user terminals such  
13 that a minimally guaranteed rate is assured for a minimum rate guaranteed  
14 class among said classified classes;  
15 scheduling data conforming to said first protocol of said minimum rate  
16 guaranteed class and of a weighting applied class among said classified  
17 classes based on said calculated weighting coefficient; and  
18 scheduling the data conforming to said first protocol of said  
19 preferential class, the data conforming to said first protocol after said  
20 weighting, and data conforming to said first protocol of a best-effort class  
21 among said classified classes such that the data conforming to said first  
22 protocol is delivered at a transmission rate equal to or lower than said  
23 calculated rate, preferentially scheduling the data conforming to said first  
24 protocol of said preferential class, preferentially scheduling the data  
25 conforming to said first protocol after said weighting at a timing at which  
26 there is no data conforming to said first protocol of said preferential class, and  
27 delivering the data conforming to said first protocol of the best-effort class at

28 a timing at which there is no data conforming to said first protocol after said  
29 weighting.

1 17. (original) A traffic shaping method, in a network connection system for  
2 connecting a communication network and a plurality of user terminals, for  
3 shaping a transmission rate for data conforming to a first protocol from said  
4 communication network, said method comprising the steps of:

5 classifying data conforming to said first protocol received from said  
6 communication network based on quality guaranteed classes set thereto;

7 correcting an overhead amount between a rate based on a second  
8 protocol and a rate based on said first protocol to convert received rate  
9 information on said second protocol to the rate based on said first protocol;

10 when the difference between the transmission rate for a preferential  
11 class among said classified classes determined using information fed back  
12 from said user terminals and said calculated rate is lower than a minimally  
13 guaranteed rate for a minimum rate guaranteed class among said classified  
14 classes, setting an upper limit to the transmission rate for said preferential  
15 class for shaping such that the minimally guaranteed rate can be assured for  
16 said minimum rate guaranteed class;

17 calculating a weighting coefficient based on said calculated rate and  
18 the transmission rate for the preferential class such that the minimally  
19 guaranteed rate is assured for said minimum rate guaranteed class, when the  
20 upper limit rate is not set for said preferential class, and calculating a  
21 weighting coefficient based on said calculated rate and said upper limit rate  
22 set for said preferential class such that the minimally guaranteed rate is  
23 assured for said minimum rate guaranteed class, when the upper limit rate is  
24 set for said preferential class;

25 scheduling data conforming to said first protocol of said minimum rate  
26 guaranteed class and of a weighting applied class among said classified  
27 classes based on said calculated weighting coefficient; and  
28 scheduling the data conforming to said first protocol of said  
29 preferential class, the data conforming to said first protocol after said  
30 weighting, and data conforming to said first protocol of a best-effort class  
31 among said classified classes such that the data conforming to said first  
32 protocol is transmitted at a transmission rate equal to or lower than said  
33 calculated rate, preferentially scheduling the data conforming to said first  
34 protocol of said preferential class, preferentially scheduling the data  
35 conforming to said first protocol after said weighting at a timing at which  
36 there is no data conforming to said first protocol of said preferential class, and  
37 delivering the data conforming to said first protocol of the best-effort class at  
38 a timing at which there is no data conforming to said first protocol after said  
39 weighting.

1 18. (original) The traffic shaping method according to claim 12, wherein said  
2 first communication network is an IP network, said data conforming to said  
3 first protocol is an IP packet, said second network is an ATM network, and  
4 said data conforming to said second protocol is an ATM cell.